New cracking method to improve the evaluation of the sealing capacity of self-healing mortar via water flow tests

Tim Van Mullem[1], Jianyun Wang[1,2], Brenda Debbaut[1], Elke Gruyaert[1], Alexandre Beirão[3], Nele De Belie[1]

[1]Magnel Laboratory for Concrete Research, Faculty of Engineering and Architecture, Ghent University, Technologiepark Zwijnaarde 904, B-9052 Ghent, Belgium

[2]Center for Microbial Ecology and Technology, Faculty of Bioscience Engineering, Ghent University, Coupure Links 653, 9000 Ghent, Belgium

[3]Devan Chemicals NV, Portugal

Upon cracking of concrete, harmful substances can migrate into the concrete, and this significantly reduces the service life of the concrete. Self-healing concrete has been developed in order to seal (regain in water tightness) and heal (regain in mechanical properties) cracks without the need for expensive manual repair treatments. This paper will focus specifically on the determination of the sealing capacity of self-healing mortar.

Different test methods have been developed in literature in order to assess the sealing capacity of self-healing mortar. All these test methods consist of cracking the specimens at a certain age, allowing them to heal, and performing the actual testing. The actual testing can e.g. consist of measuring the water flow through a crack or measuring the capillary water absorption of a cracked mortar. The results of these tests are all very sensitive to the crack width. Due to the inherent variability of concrete, there is often a large deviation from the desired crack width. Consequently, the variance on the results of the sealing efficiency is for a large part determined by the scatter on the crack width (Gruyaert et al., 2016; Tziviloglou et al., 2016a).

In order to reduce the variability related to the cracks, different cracking methods were investigated in this research. Firstly, reinforced prismatic specimens (40 mm x 40 mm x 160 mm) with different types of notches were cast. After 28 days they were cracked in a crack-width-controlled three-point-bending test. Immediately after cracking, spacers were inserted in the notches to obtain the desired crack width and to prevent partial crack closing due to elastic regain of the reinforcement upon unloading. Secondly, at the age of 27 days CFRP laminates were glued upon the top

side of unreinforced prismatic specimens (40 mm x 40 mm x 160 mm). At the age of 28 days these were cracked in two halves in a three-point-bending test. The two halves remained connected at their top side due to the CFRP. The desired crack width was then obtained by clamping the specimens in a screw jack.

After crack introduction, the final crack width was measured by optical microscopy. If the variability on the crack width was acceptable, it was tested whether the variability of the sealing efficiency of both reference and self-healing specimens, was limited. The self-healing mortars contained micro-encapsulated (10-25 µm capsule diameter) *Bacillus sphaericus*, produced by Devan Chemicals NV. For the determination of the sealing efficiency a slightly updated version of the water flow test (Gruyaert et al., 2016; Tziviloglou et al., 2016b), developed in HEALCON (EU-FP7), was used. In order to perform this test, the specimens were provided with a cast-in hole of 5 mm. A water head of 0.5 m was induced on this hole, and the mass of the water leaking out of the hole via the crack was measured over time.

The three-page paper will elaborate on the effect of the cracking method on the variability of the crack width and the sealing efficiency. The effect of the encapsulated bacteria on the compressive and the flexural strength will also be reported.

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